Understanding C Arrays

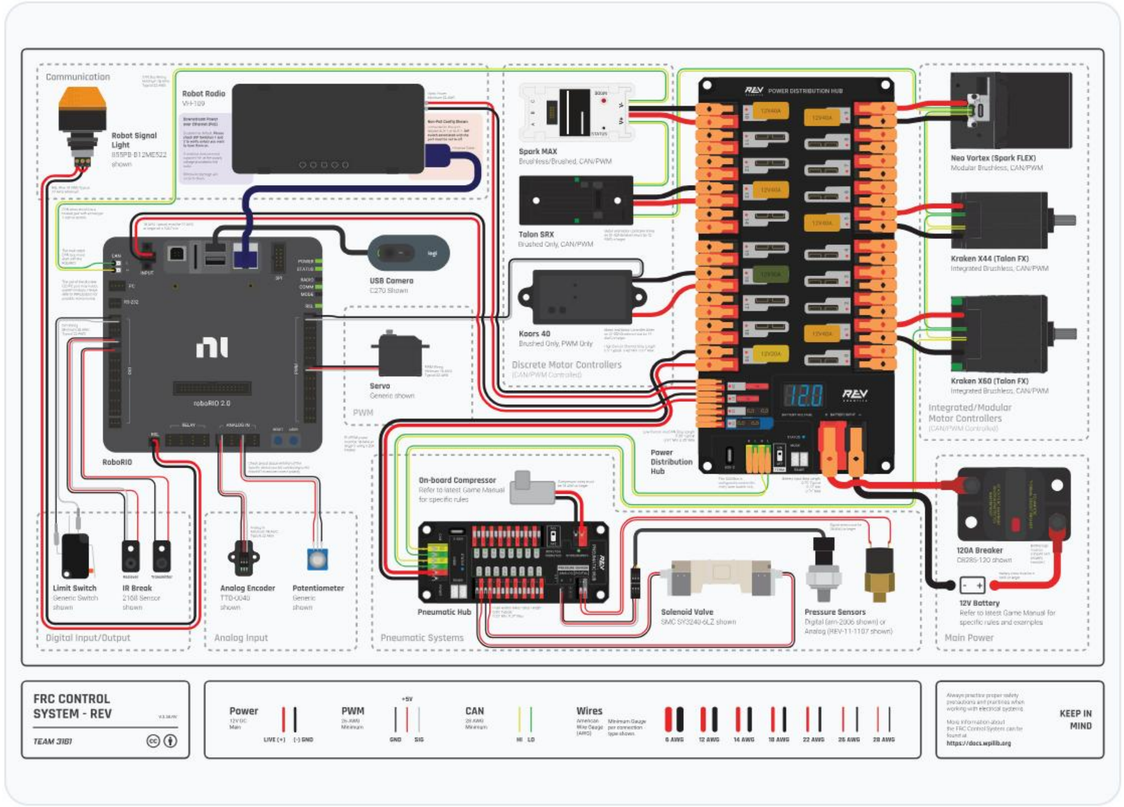
A Computer Programming Assignment

What is an Array?

The "Boxes" Analogy

Think of an array as a row of connected boxes. Each box can hold one item, and all items must be the *same type* (e.g., all integers).

- Stores multiple values under one name.
- All values must be the same data type.
- Stored in contiguous (side-by-side) memory.



Why Use Arrays?

- **Organize Data:** Store 100 student grades under one variable name (`grades`) instead of 100 different ones (`grade1`, `grade2`...).
- **Efficient Processing:** Easily process many values using a simple loop. This is the biggest advantage!
- **Clean Code:** Makes your code shorter, cleaner, and easier to read and maintain.

How to Create an Array

Declaration (Syntax)

This reserves the space in memory. You must specify the type and the size.

```
int scores[5];
```

Initialization (Giving Values)

You can give the array its values when you declare it.

```
int scores[5] = {90, 85, 92, 78, 95};
```

Accessing Elements (The Key Rule)

Indexing Starts at 0!

This is the most important concept. The first "box" is not 1, it's **0**.

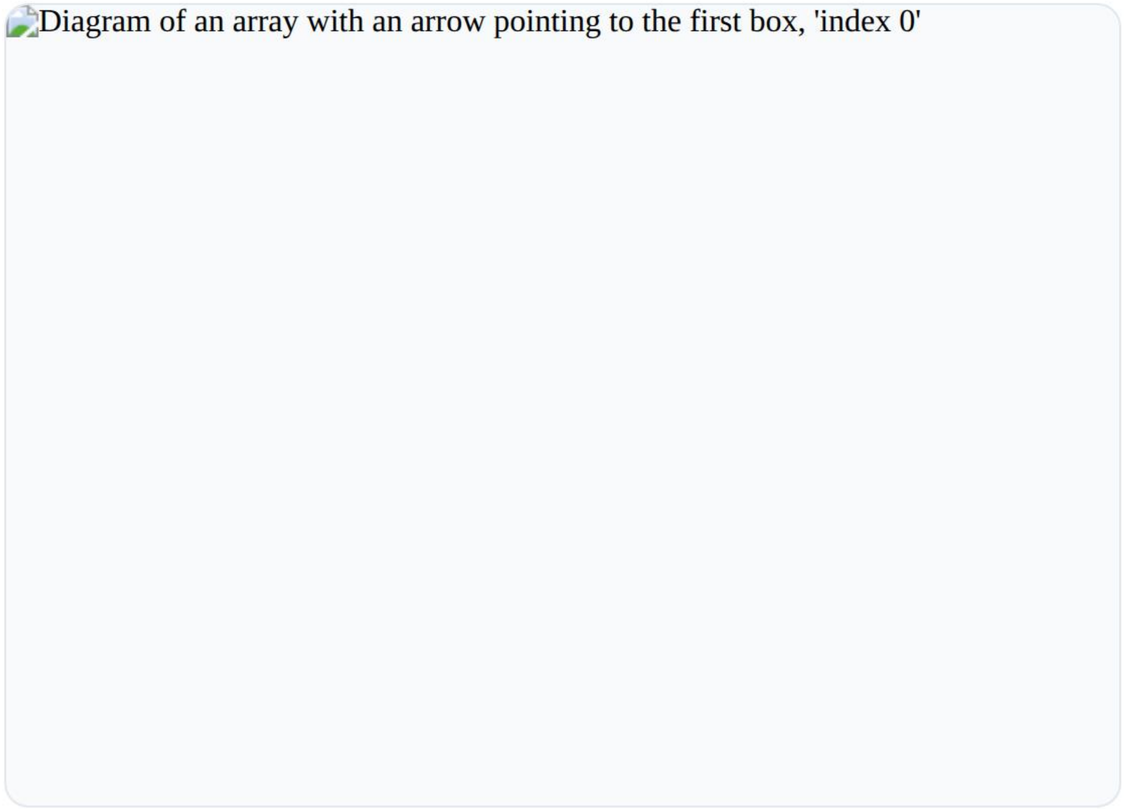
- `scores[0]` is the 1st element (90)
- `scores[1]` is the 2nd element (85)
- `scores[4]` is the 5th (last) element (95)

To get a value:

```
int firstScore = scores[0];
```

To set a value:

```
scores[2] = 88; // Changes 92 to 88
```



Arrays and Loops

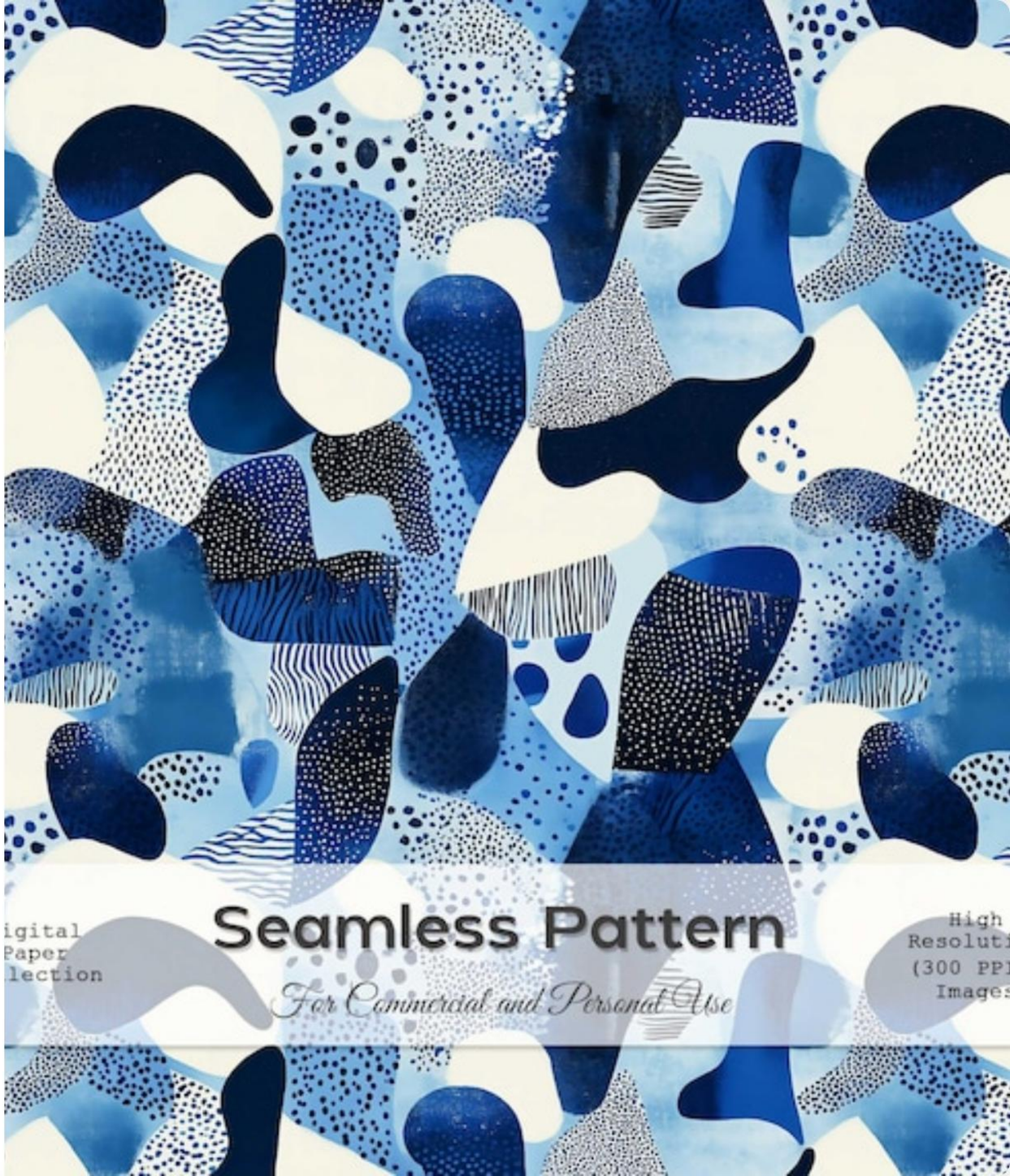
This is their superpower!

A `for` loop is perfect for "iterating" (going through) an array, one element at a time.

Let's print every score:

```
int scores[] = {90, 85, 92, 78, 95};
int i;

for (i = 0; i < 5; i++) {
    printf("Score %d: %d\n", i, scores[i]);
}
```



Code Input & Output

Input (The Code)

```
for (i = 0; i < 5; i++) {
    printf("Score %d: %d\n", i, scores[i]);
}
```

Output (The Console)

```
Score 0: 90
Score 1: 85
Score 2: 92
Score 3: 78
Score 4: 95
```

Case Study:
Class Average Calculator

Case Study: The Problem

- **Goal:** A teacher needs a program to calculate the class average for 5 students.
- **Step 1:** The program must ask the user to enter 5 grades.
- **Step 2:** It must store these grades as they are entered. (Hint: Use an array!)
- **Step 3:** It must calculate the total sum of all grades.
- **Step 4:** It must compute the average and print it to the screen.

Case Study: The Code

```
#include

int main() {
    int grades[5];
    int i;
    float total = 0;
    float average;

    // 1. Get grades from user
    for (i = 0; i < 5; i++) {
        printf("Enter grade %d: ", i + 1);
        scanf("%d", &grades[i]);
    }

    // 2. Calculate total
    for (i = 0; i < 5; i++) {
        total += grades[i]; // Add current grade
    }

    // 3. Calculate and print average
    average = total / 5.0; // Use 5.0 for float
    printf("The class average is: %.2f\n", average);

    return 0;
}
```

Case Study: Input & Output

User Input (Console)

```
Enter grade 1: 80
Enter grade 2: 90
Enter grade 3: 100
Enter grade 4: 70
Enter grade 5: 85
```

Final Output (Console)

```
The class average is: 85.00
```

2D Arrays (A Quick Look)

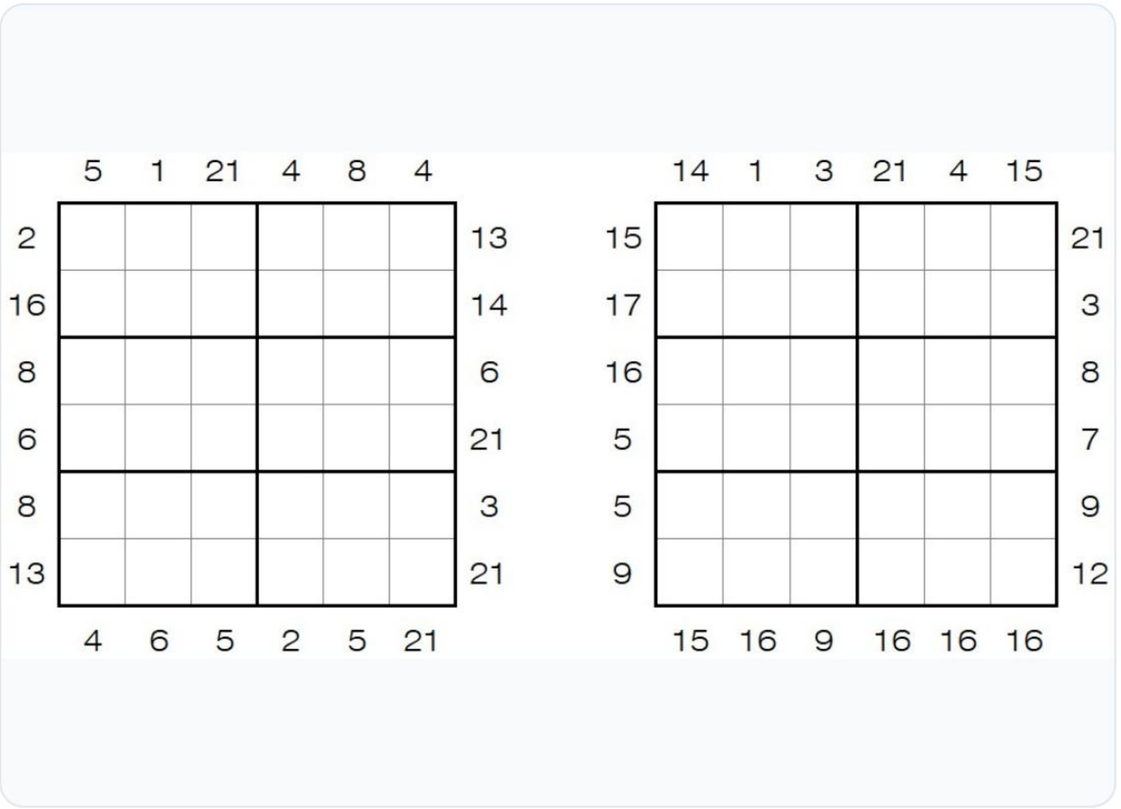
Arrays can have more than one dimension. A 2D array is like a grid or a table with rows and columns.

This is useful for a tic-tac-toe board or a map.

Declaration:

```
// A 2x3 matrix (2 rows, 3 cols)
int matrix[2][3] = {
    {1, 2, 3},
    {4, 5, 6}
};

// Access the '5'
int x = matrix[1][1];
```



Key Takeaways

- Arrays are for storing multiple values of the **same type**.
- Array indexing always, *always* starts at **0**. Not 1.
- `for` loops are the perfect tool to process every element in an array.
- Arrays are a fundamental building block for organizing data.

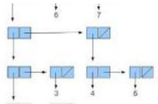
Questions?

Thank you!

Image Sources

https://docs.wpilib.org/en/stable/_images/frc-control-system-layout-rev.svg

Source: docs.wpilib.org



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Source: stackoverflow.com

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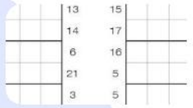
Source: www.etsy.com

https://png.pngtree.com/png-vector/20250825/ourmid/pngtree-school-diary-with-grades-minimalist-icon-on-white-background-png-image_17241358.webp

Source: pngtree.com



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